

CLAIMS

1. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, wherein
5 the ligand shows a coloring property by chelating the metal atom.

2. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, and
10 having a peak of an absorption spectrum between 350 nm and 800 nm.

3. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, wherein
15 the ligand shows a light-emitting property by chelating the metal atom.

4. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, and
20 having a peak of an emission spectrum between 380 nm and 760 nm.

5. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, wherein
25 the ligand shows semiconductivity by chelating the metal atom.

6. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a phenolic
30 hydroxy group is bonded to the metal atom, wherein the ligand further has a heterocycle with a nitrogen atom as a hetero atom, and chelates the metal atom by the oxygen atom and the nitrogen atom.

7. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a phenolic
35 hydroxy group is bonded to the metal atom, wherein the ligand further has a carbonyl

group, and chelates the metal atom by the oxygen atom and the carbonyl group.

8. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a phenolic hydroxy group is bonded to the metal atom, wherein the ligand further has an azomethyne group, and chelates the metal atom by the oxygen atom and the azomethyne group.

9. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a carboxyl group is bonded to the metal atom, wherein the ligand further has a heterocycle with a nitrogen atom as a hetero atom, and chelates the metal atom by the oxygen atom and the nitrogen atom.

10. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a carboxyl group is bonded to the metal atom, wherein the ligand further has a carbonyl group, and chelates the metal atom by the oxygen atom and the carbonyl group.

11. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a carboxyl group is bonded to the metal atom, wherein the ligand further has a azomethyne group, and chelates the metal atom by the oxygen atom and the azomethyne group.

12. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand in which an oxygen atom from a hydroxylamino group is bonded to the metal atom, wherein the ligand further has a carbonyl group, and chelates the metal atom by the oxygen atom and the carbonyl group.

13. An organic-inorganic hybrid material having a metal oxide matrix having one kind or plural kinds of metal atoms, and a ligand bonded to the metal atom by chelating, wherein a ligand having any structure of 8 - hydroxyquinoline and derivatives thereof, 10 -

hydroxybenzo [h] - quinoline and derivatives thereof, 2 - (2 - hydroxyphenyl) benzoxazole and derivatives thereof, 2 - (2 - hydroxyphenyl) benzothiazole and derivatives thereof, 2 - (2 - hydroxyphenyl) benzoimidazole and derivatives thereof, 2 - (2 - hydroxyphenyl) pyridine and derivatives thereof, 3 - hydroxyflavone and derivatives thereof, 5 - hydroxyflavone and derivatives thereof, salicylideneamine and derivatives thereof, picolinic acid and derivatives thereof, coumarin - 3 - carboxylic acid and derivatives thereof, salicylidene aminoacid and derivatives thereof, benzylideneamino acid and derivatives thereof, N - benzoyl - N - phenyl - hydroxylamine and derivatives thereof, and N - cinnamoyl - N - phenyl - hydroxylamine and derivatives thereof is used as the ligand.

10

14. The organic-inorganic hybrid material according to any one of claims 1 to 13, wherein the metal atom is any of selected from the group consisting of magnesium, calcium, strontium, barium, scandium, yttrium, lanthanum, titanium, zirconium, hafnium, zinc, aluminum, gallium, and indium.

15

15. The organic-inorganic hybrid material according to any one of claims 1 to 13, further including a silica moiety or an organosiloxane moiety.

20

16. The organic-inorganic hybrid material according to any one of claims 1 to 13, further including an aromatic moiety.

17. The organic-inorganic hybrid material according to claim 16, wherein the aromatic compound is an organic pigment, an organic light emitter, or an organic semiconductor.

25

18. The organic-inorganic hybrid material according to any one of claims 1 to 13 used in a carrier-injection type electroluminescent device.

19. The organic-inorganic hybrid material according to any one of claims 1 to 13 is used in an intrinsic electroluminescent device.

30

20. A light-emitting device using the carrier-injection type electroluminescent device

described in claim 18.

21. A light-emitting device using the intrinsic electroluminescent device described in claim 19.

5

22. A glass product coated with the organic-inorganic hybrid material described in any one of claims 1 to 13.

23. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing a coloring property by chelating the metal atom, and an organic solvent.

10 24. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing a 15 light-emitting property by chelating the metal atom, and an organic solvent.

25. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing semiconductivity by chelating the metal atom, and an organic solvent.

20

26. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a phenolic hydroxy group and a heterocycle with a nitrogen atom as a hetero atom, and an organic solvent.

25

27. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a phenolic hydroxy group and a carbonyl group, and an organic solvent.

30 28. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a

phenolic hydroxy group and an azomethyne group, and an organic solvent.

29. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a 5 carboxyl group and a heterocycle with a nitrogen atom as a hetero atom, and an organic solvent.

30. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a 10 carboxyl group and a carbonyl group, and an organic solvent.

31. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a carboxyl group and an azomethyne group, and an organic solvent.

15 32. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a hydroxylamino group and a carbonyl group, and an organic solvent.

20 33. A composition for coating application, including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound chelating the metal atom, and an organic solvent, wherein the organic compound is any of 8 - hydroxyquinoline and derivatives thereof, 10 - hydroxybenzo [h] - quinoline and derivatives thereof, 2 - (2 - hydroxyphenyl) benzoxazole and derivatives thereof, 2 - (2 - 25 hydroxyphenyl) benzothiazole and derivatives thereof, 2 - (2 - hydroxyphenyl) benzoimidazole and derivatives thereof, 2 - (2 - hydroxyphenyl) pyridine and derivatives thereof, 3 - hydroxyflavone and derivatives thereof, 5 - hydroxyflavone and derivatives thereof, salicylideneamine and derivatives thereof, picolinic acid and derivatives thereof, coumarin - 3 - carboxylic acid and derivatives thereof, salicylidene aminoacid and derivatives thereof, benzylideneamino acid and derivatives thereof, N - benzoyl - N - 30 phenyl - hydroxylamine and derivatives thereof, and N - cinnamoyl - N - phenyl -

hydroxylamine and derivatives thereof.

34. The composition for coating application according to any one of claims 23 to 33, wherein the metal atom is any selected from the group consisting of magnesium, calcium, strontium, barium, titanium, zirconium, hafnium, zinc, aluminum, gallium, and indium.
- 5
35. The composition for coating application according to any one of claims 23 to 33, further including an alkoxy silane, an organoalkoxy silane, and/or an organosiloxane.
- 10 36. The composition for coating application according to claim 35, wherein the number of silicon atoms of the alkoxy silane, the organoalkoxy silane, and/or the organosiloxane is 0.5 equivalent or more and 10 equivalents or less for the number of the metal atoms.
- 15 37. The composition for coating application according to any one of claims 23 to 33, wherein the amount of the organic compound is 1 equivalent or less for the metal alkoxide and/or the metal salt.
- 20 38. The composition for coating application according to any one of claims 23 to 33, wherein the organic solvent is an organic solvent including a lower alcohol, tetrahydrofuran, or acetonitril.
- 25 39. The composition for coating application according to claim 38, wherein the lower alcohol any selected from the group consisting of methanol, ethanol, n-propanol, isopropanol, n-butanol, sec-butanol, and tert-butanol.
40. The composition for coating application according to any one of claims 23 to 33, further including water.
- 30 41. The composition for coating application according to claim 40, wherein the amount of the added water is 2 equivalents or more and 6 equivalents or less for the metal alkoxide and/or the metal salt.

42. The composition for coating application according to any one of claims 23 to 33, further including a chemical modifier.

5 43. The composition for coating application according to claim 42, wherein the chemical modifier is β -diketone.

44. The composition for coating application according to claim 42, wherein the amount of the added chemical modifier is 0.5 equivalent or more and 6 equivalents or less for the 10 metal alkoxide and/or the metal salt.

45. The composition for coating application described in any one of claims 23 to 33, further including an aromatic compound.

15 46. The composition for coating application according to claim 45, wherein the aromatic compound is an organic pigment, an organic light emitter, or an organic smieoncductor.

47. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a 20 metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing a coloring property by chelating the metal atom, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 $^{\circ}\text{C}$ or more and 300 $^{\circ}\text{C}$ or less under an atmospheric pressure or under a reduced pressure.

25 48. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing a light-emitting property by chelating the metal atom, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 30 $^{\circ}\text{C}$ or more and 300 $^{\circ}\text{C}$ or less under an atmospheric pressure or under a reduced pressure.

49. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound showing semiconductivity by chelating the metal atom, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

50. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a phenolic hydroxy group and a heterocycle with a nitrogen atom as a hetero atom, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

15 51. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a phenolic hydroxy group and a carbonyl group, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

20 52. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a phenolic hydroxy group and an azomethyne group, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

25 53. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a

metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a carboxyl group and a heterocycle with a nitrogen atom as a hetero atom, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a 5 reduced pressure.

54. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an 10 organic compound having a carboxyl group and a carbonyl group, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

55. A method of manufacturing an organic-inorganic hybrid material, comprising a first 15 step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a carboxyl group and an azomethyne group, and an organic solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

20 56. A method of manufacturing an organic-inorganic hybrid material, comprising a first step of performing wet coating of a composition for coating application including at least a metal alkoxide having one kind or plural kinds of metal atoms and/or a metal salt, an organic compound having a hydroxylamino group and a carbonyl group, and an organic 25 solvent, on a base material, and a second step of calcining at a temperature of 100 °C or more and 300 °C or less under an atmospheric pressure or under a reduced pressure.

57. A composition for coating application, including at least a metal alkoxide having one 30 kind or plural kinds of metal atoms and/or a metal salt, an organic compound chelating the metal atom, and an organic solvent, wherein the organic compound is any of 8 - hydroxyquinoline and derivatives thereof, 10 - hydroxybenzo [h] - quinoline and

derivatives thereof, 2 - (2 - hydroxyphenyl) benzoxazole and derivatives thereof, 2 - (2 - hydroxyphenyl) benzothiazole and derivatives thereof, 2 - (2 - hydroxyphenyl) benzoimidazole and derivatives thereof, 2 - (2 - hydroxyphenyl) pyridine and derivatives thereof, 3 - hydroxyflavone and derivatives thereof, 5 - hydroxyflavone and derivatives thereof, 5 - hydroxyflavone and derivatives thereof, salicylideneamine and derivatives thereof, picolinic acid and derivatives thereof, coumarin - 3 - carboxylic acid and derivatives thereof, salicylidene aminoacid and derivatives thereof, benzylideneamino acid and derivatives thereof, N - benzoyl - N - phenyl - hydroxylamine and derivatives thereof, and N - cynamoyl - N - phenyl - hydroxylamine and derivatives thereof.

10 58. The method of manufacturing the organic-inorganic hybrid material according to any one of claims 47 to 57, wherein the composition for coating application further includes β -diketon as a chemical modifier.

15 59. The method of manufacturing the organic-inorganic hybrid material according to any one of claims 47 to 57, wherein the wet coating is any of a dip coating method, a spin coating, and an inkjet method.

20

25

30